

CLAIMS

1. A method of analyzing an object comprising:
 - scanning the object with at least two beams of different energies from a plurality of angles to create at least high and low energy readings;
 - 5 determining a density of at least a portion of the object;
 - updating the density based on the high and low energy readings.
2. The method of claim 1 further comprising reconstructing an image of at least a portion of the object using computed tomography wherein the updating occurs before,
10 during or after the image is reconstructed.
3. A method of screening items to detect target objects therein, comprising:
 - a) passing X-rays through an item from a plurality of different angles and with a plurality of energy levels;
 - 15 b) detecting X-rays that have been attenuated by passing through the item to produce detected values representative of the attenuation of the X-rays by the item;
 - c) analyzing the detected values to produce a first representation of objects within the item, the objects in the first representation being based at least in part on a ratio of attenuation of x-rays having different energies;
 - 20 d) performing a computed tomographic reconstruction of at least a portion of the detected values to produce a second representation of one or more objects within the item; and
 - e) forming a third representation of objects in the item by combining the first and second representations.
 - 25
4. A method of screening items to detect target objects therein, comprising:
 - a) passing X-rays through an item from a plurality of different angles and with a plurality of energy levels;
 - b) detecting X-rays that have been attenuated by passing through the item to
30 produce detected values representative of the attenuation of the X-rays by the item;

- c) analyzing at least a portion of the detected values to produce a first representation of objects within the item, the objects in the first representation being based at least in part on a ratio of attention of x-rays having different energies;
- d) performing a computation on at least a portion of the detected values to
5 compute density of a portion of the item; and
- e) using the density information to determine whether to update the first representation of objects.

5. The method of claim 3 wherein the first representation includes as objects areas
10 within a scan of an item having similar atomic number.

6. The method of claim 5 wherein forming the third representation includes altering the first representation by changing the estimate of the atomic number of an object based on the second representation of objects.
15

7. The method of claim 5 wherein the first representation represents as objects areas within a scan of items of similar atomic number and mass.

8. The method of claim 3 wherein forming the third representation includes altering
20 a representation of an object in the first representation based on the second representation indicating that a plurality of overlapping objects are represented as one object in the first representation.

9. The method of claim 3 wherein the second representation of objects is based on
25 density of objects.

10. The method of claim 3 wherein analyzing the detected values includes forming a two dimensional array of pixels representing the item.

30 11. The method of claim 10 wherein analyzing the detected values includes identifying regions in the two dimensional array of pixels in which the pixels have similar atomic number and mass.

12. The method of claim 11 wherein regions of similar atomic number are determined from pixels having similar ratios of attenuation of x-rays at two different energies and mass is determined from pixels having similar attenuation of x-rays at the same energy.

13. The method of claim 3 wherein producing the first representation includes assigning an effective atomic number to each object.

14. The method of claim 13 additionally comprising selecting objects of interest based in part on the effective atomic numbers and wherein performing the computed tomographic reconstruction is altered by the selected objects of interest.

15. The method of claim 14 wherein the computed tomographic reconstruction reconstructs a slice of the item selected to pass through an object of interest.

16. The method of claim 3 wherein the first representation represents objects in a two dimensional coordinate system and the second representation represents objects in a three dimensional coordinate system.

17. The method of claim 3 wherein the first representation is formed from an image of the item from only one view.

18. The method of claim 3 wherein forming a third representation includes altering the effective atomic number and mass associated with objects contained in the first representation based on density of objects contained in second representation.

19. The method of claim 3 additionally comprising automatically identifying a target object based on the third representation.

20. The method of claim 3 wherein the second representation of objects includes a confidence associated with each object.

21. The method of claim 3 wherein analyzing the detected values includes:
i) forming a plurality of pixels and
ii) grouping pixels of similar characteristics and assigning a confidence level to
5 each grouping.
22. The method of claim 21 wherein assigning a confidence level includes assigning
a confidence level based on the compactness of the grouping.
- 10 23. The method of claim 21 wherein assigning a confidence level includes assigning
a confidence level based on the connectiveness of the grouping.
24. The method of claim 21 wherein assigning a confidence level includes assigning
a confidence level based on the gradient of the grouping.
15
25. The method of claim 21 wherein assigning a confidence level includes assigning
a confidence level based on the histogram spread of the grouping.
26. A method of analyzing an object to identify a target object comprising:
20 performing a dual energy computed tomography scan of at least a portion of the
object; and
analyzing information relating to an effective atomic number and a density of at
least part of the portion of the object to determine a likelihood that the object is a target,
wherein analyzing also considers at least one of confidence levels of information relating
25 to atomic number and density, thickness of a portion of the object and proximity of the
object to metal.
27. A method of screening items to detect target objects therein, comprising:
a) passing X-rays through an item from a plurality of different angles and with a
30 plurality of energy levels;
b) detecting X-rays that have been attenuated by passing through the item to
produce detected values representative of the attenuation of the X-rays by the item;

c) performing a computed tomographic reconstruction of at least a portion of the detected values to produce a representation of one or more objects within the item, the representation including an association between each object and a value indicative of density;

5 d) analyzing at least a portion of the detected values to associate a value indicative of effective atomic number with the objects, the value indicative of effective atomic number being based at least in part on a ratio of attention of x-rays having different energies;

 e) assigning a confidence value to at least one of the value indicative of density
10 and the value indicative of effective atomic number; and

 f) indicating an object based on the representation, including the values indicative of density and effective atomic number and the confidence.

28. The method of claim 27 wherein indicating an object includes indicating the
15 object is a target.

29. The method of claim 27 wherein indicating an object includes indicating an object and a probability the object is a target.

20 30. The method of claim 27 wherein indicating an object includes comparing values indicative of effective atomic number and physical extent of objects to predetermined information on the effective atomic number and physical extent of target objects.

31. The method of claim 30 wherein the predetermined information includes a
25 histogram of probabilities that an object having a combination of atomic numbers and physical dimensions is a target object.

32. A method of screening items to detect target objects therein, comprising:
a) passing X-rays through an item from a plurality of different angles and with a
30 plurality of energy levels;

 b) detecting X-rays that have been attenuated by passing through the item to produce detected values representative of the attenuation of the X-rays by the item;

c) analyzing the detected values to produce a first representation of objects within the item, the first representation being based at least in part on a ratio of attention of x-rays having different energies;

5 d) performing a computed tomographic reconstruction of at least a portion of the detected values to produce a second representation of one or more objects within the item;

e) indicating an object based on the first representation, the second representation and the confidence, wherein objects are indicated when they have an effective atomic number in a predetermined range and a predetermined proximity to
10 another object that has an effective atomic number indicative of metal.